



US010974756B2

(12) **United States Patent**  
**Cana et al.**

(10) **Patent No.:** **US 10,974,756 B2**  
(45) **Date of Patent:** **Apr. 13, 2021**

(54) **CLUTCH DEVICE LATCHING SYSTEM AND METHOD**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 177 days.

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(21) Appl. No.: **16/050,832**

(22) Filed: **Jul. 31, 2018**

(65) **Prior Publication Data**

US 2020/0039563 A1 Feb. 6, 2020

(51) **Int. Cl.**

**B62D 1/184** (2006.01)

**B62D 1/185** (2006.01)

**B62D 1/183** (2006.01)

(52) **U.S. Cl.**

CPC ..... **B62D 1/184** (2013.01); **B62D 1/183** (2013.01); **B62D 1/185** (2013.01)

(58) **Field of Classification Search**

CPC ..... B62D 1/184; B62D 1/183; B62D 1/185; B62D 1/181

See application file for complete search history.

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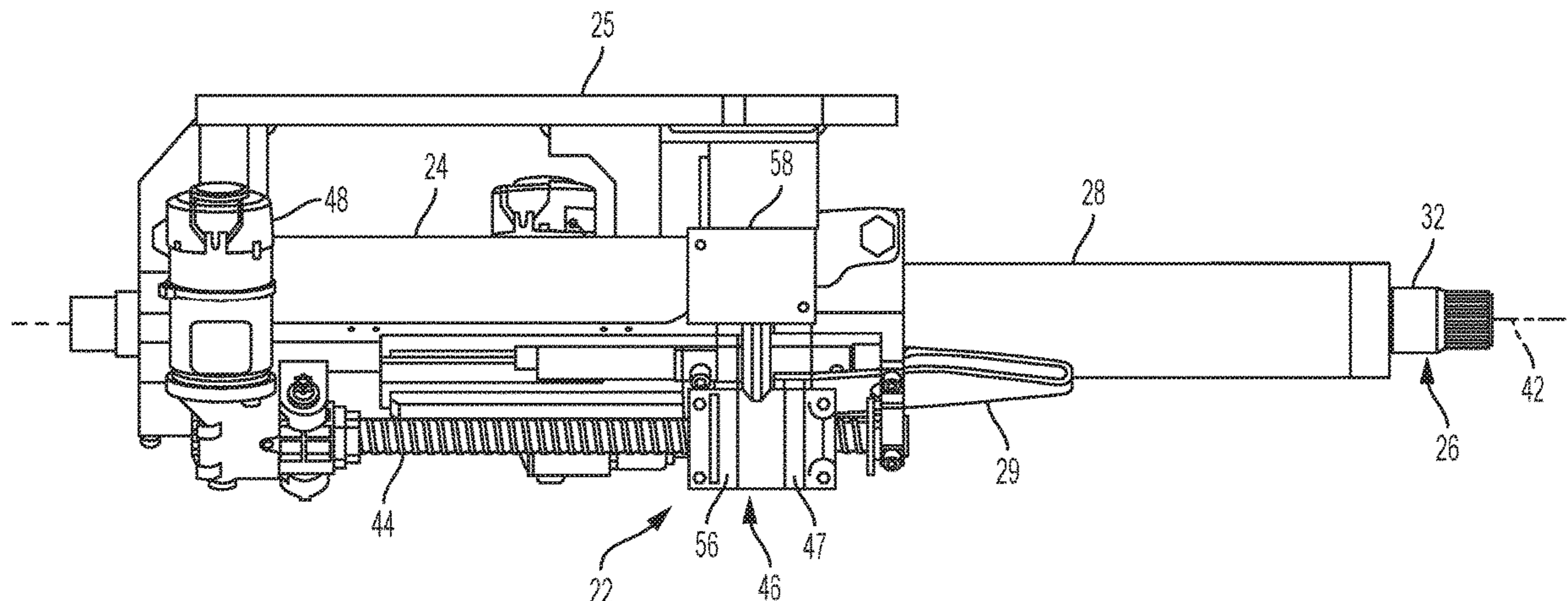
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(57) **ABSTRACT**

A retractable steering column assembly includes a retractable portion. Also included is an electric actuator mechanism for translating and/or tilting the retractable portion. Further included is a latch moveable between a latched condition and an unlatched condition, the unlatched condition allowing manual adjustment of the retractable portion, the latched condition preventing manual adjustment of the retractable portion.

**12 Claims, 5 Drawing Sheets**



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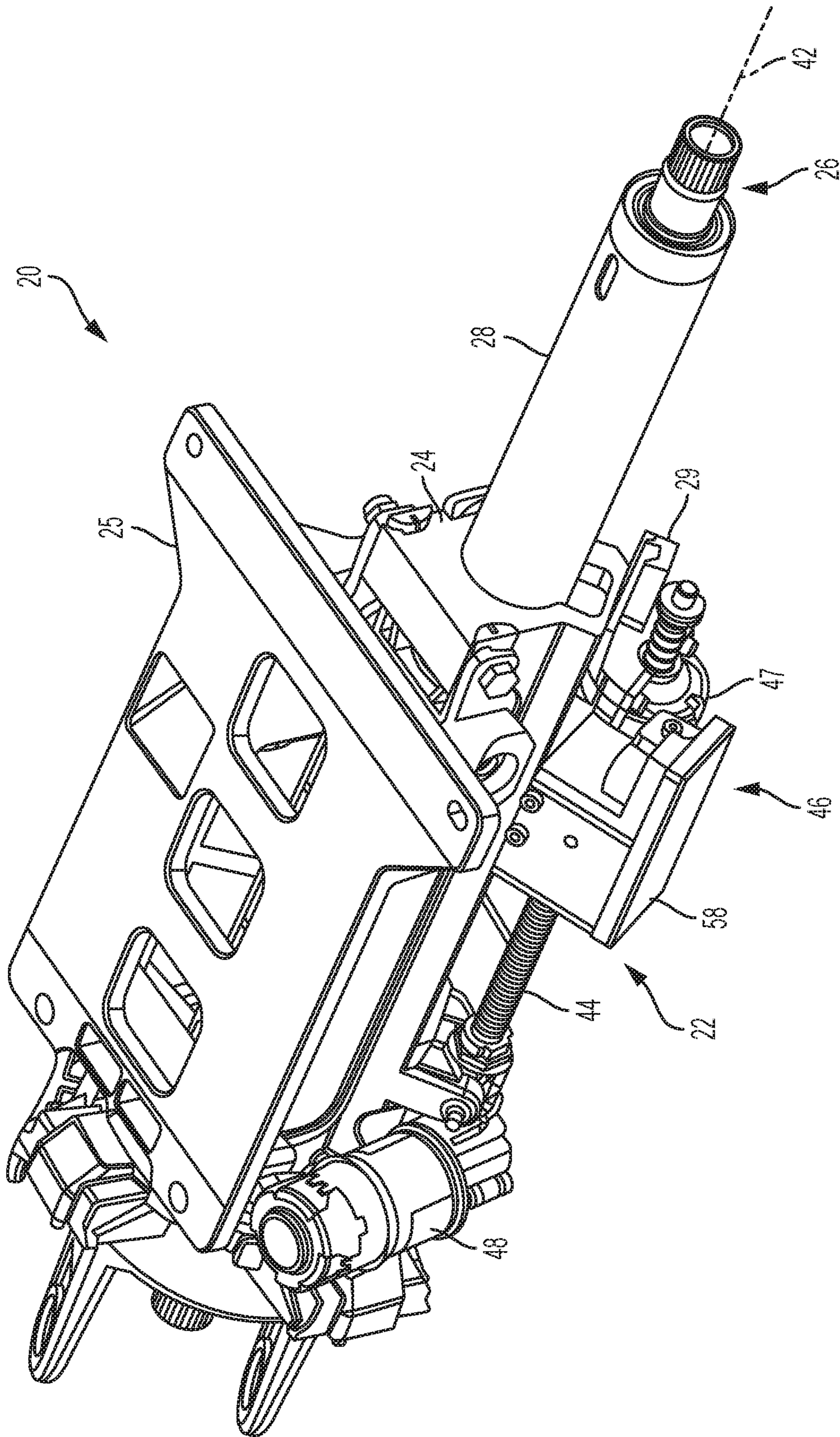
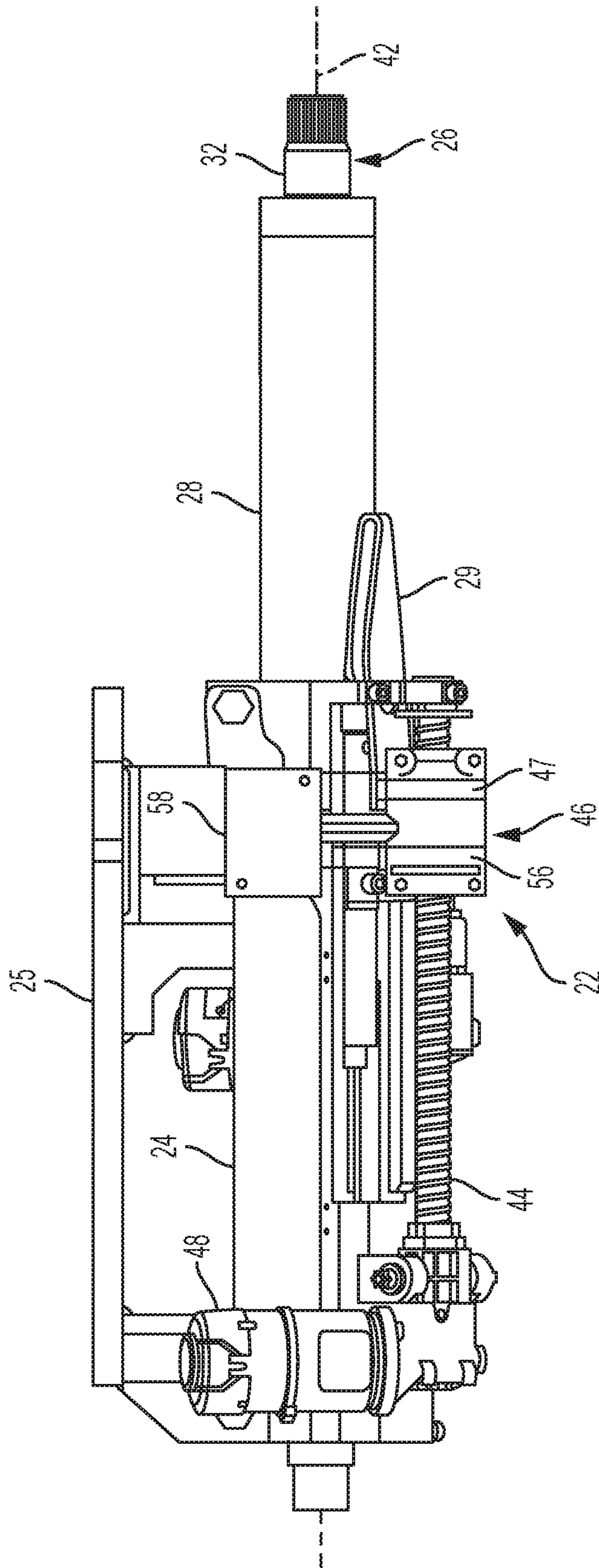


FIG. 1



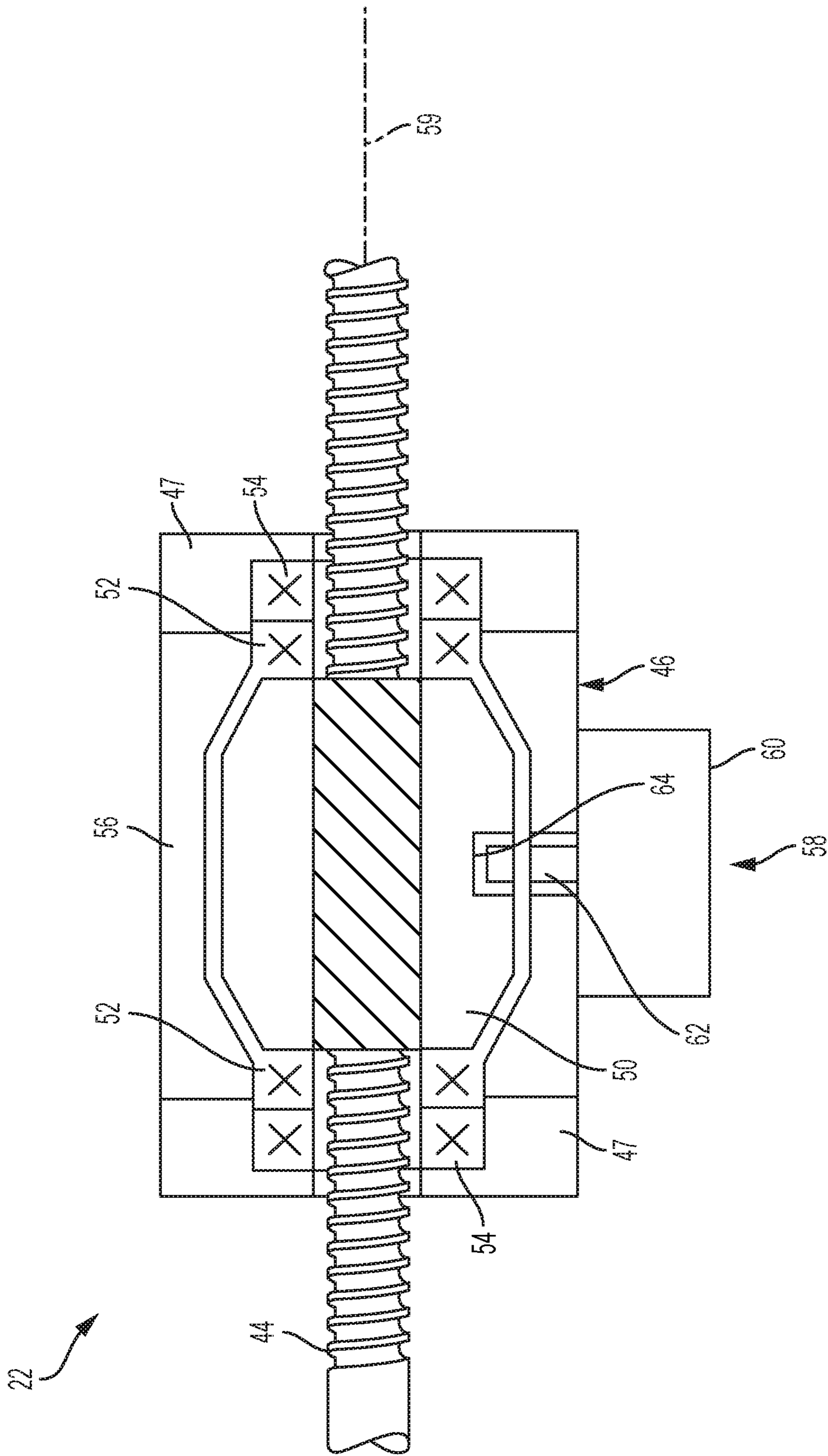


FIG. 3

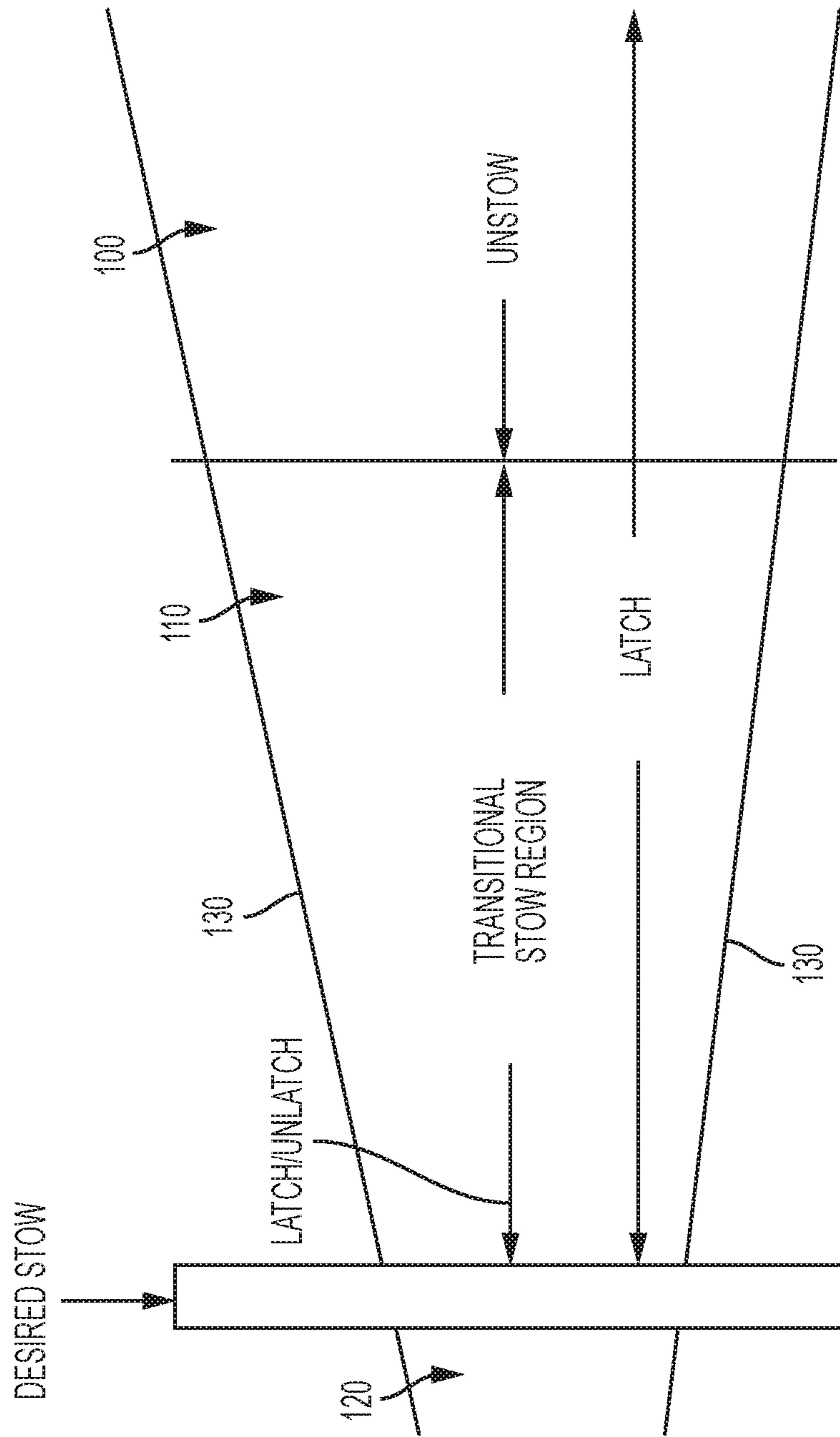


FIG. 4



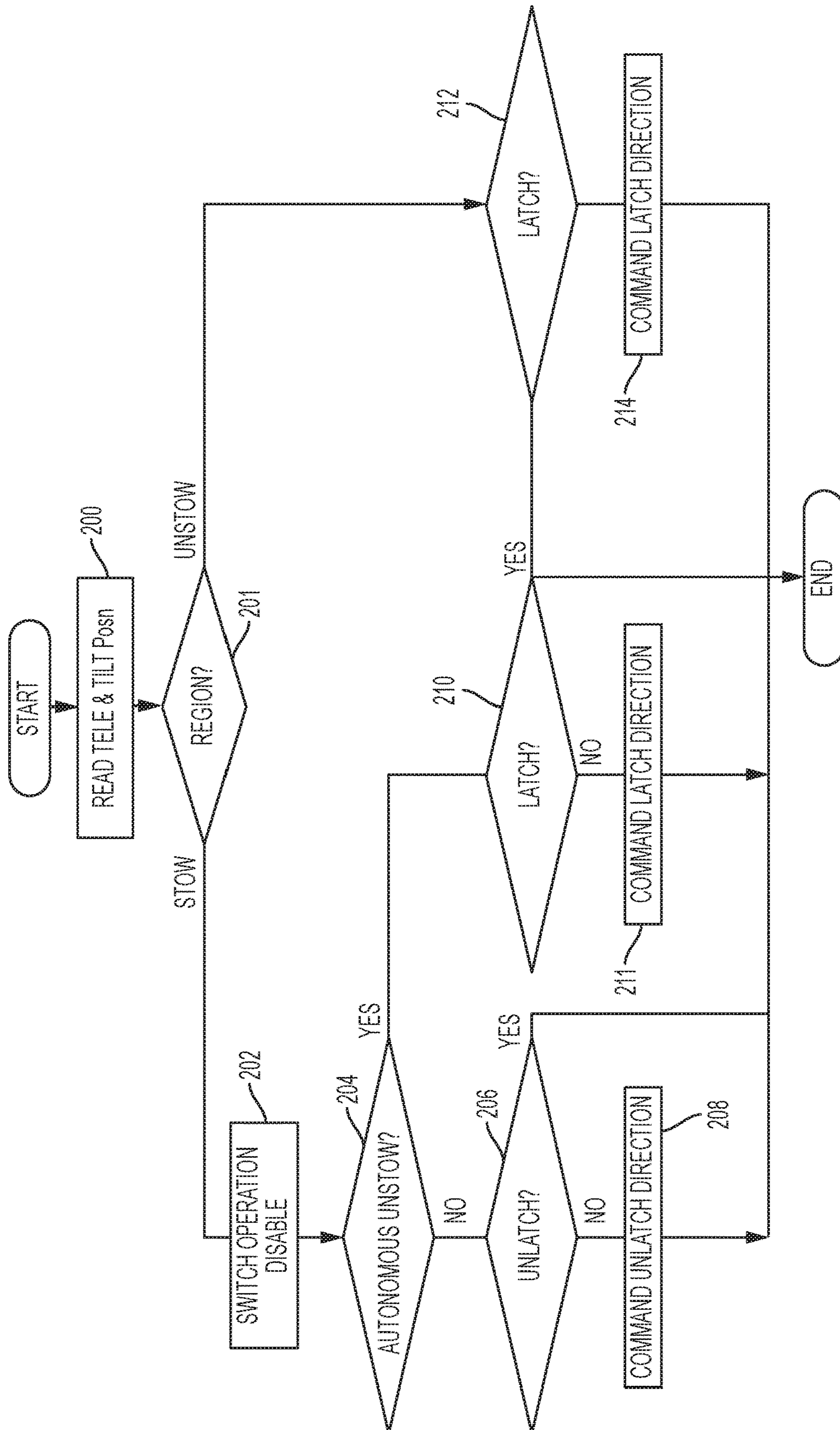


FIG. 5

## CLUTCH DEVICE LATCHING SYSTEM AND METHOD

### BACKGROUND OF THE INVENTION

The embodiments described herein relate to retracting steering column assemblies and, more particularly, to a system and method associated with a clutch device latching system.

As autonomously driven vehicles are developed, a number of opportunities will evolve related to comfort, entertainment and functionality for drivers. Steering wheels are commonly limited to standard driving positions due to the need for a driver to handle the steering wheel during operation of the vehicle. These limitations may be unnecessary during an autonomous driving mode of a vehicle. For example, a steering wheel may be retracted to a stowed position to enlarge the space available for a driver.

An automated, electromechanical system is often relied upon to translate the steering column between an extended position and a retracted position. Some systems also allow manual adjustment of the steering column, but a clutch device and nut in a power column currently require a driver to wait until the column extends away from a retracted (also referred to as stowed) position before manual adjustment is available.

### SUMMARY OF THE INVENTION

According to an aspect of the disclosure, a retractable steering column assembly includes a retractable portion. Also included is an electric actuator mechanism for translating and/or tilting the retractable portion. Further included is a latch moveable between a latched condition and an unlatched condition, the unlatched condition allowing manual adjustment of the retractable portion, the latched condition preventing manual adjustment of the retractable portion.

According to another aspect of the disclosure, a method of controlling adjustment of a steering column assembly is provided. The method includes detecting a position of the steering column assembly. The method also includes determining which one of a plurality of regions the telescope position is within. The method further includes unlatching a latch selectively engageable with the steering column assembly to allow manual adjustment of the steering column assembly if the steering column assembly is within at least one of the plurality of regions. The method yet further includes latching the latch to prevent manual adjustment of the steering column assembly if the retractable portion is within at least one of the plurality of regions.

These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a steering column assembly;

FIG. 2 is an elevational view of the steering column assembly;

FIG. 3 is a sectional view of a portion of the steering column assembly;

FIG. 4 is a diagram illustrating multiple regions associated with stowed and unstowed positions of the steering column assembly; and

FIG. 5 is a flow diagram illustrating a method of controlling the steering column assembly.

### DETAILED DESCRIPTION

Referring now to the Figures, where the invention will be described with reference to specific embodiments, without limiting same, FIG. 1 illustrates a steering column assembly 20. The steering column assembly 20 facilitates translation of a steering wheel (not shown) and a steering shaft 26 in a retractable manner. This is particularly beneficial in embodiments where the assembly 20 is employed in a passenger vehicle equipped with Advanced Driver Assist System(s) (ADAS) to allow the vehicle to be autonomously, or semi-autonomously, controlled using sensing, steering, and/or braking technology. When the ADAS is activated, the steering wheel is not required for vehicle control in some situations. Retraction of the steering wheel and steering shaft 26 toward, and possibly into, the instrument cluster greatly enhances user comfort by providing a driver with more space. The additional space provided facilitates additional workspace area or leg room, for example.

The embodiments described herein provide a retractable steering column which allows the steering wheel to be retracted while the vehicle is in an autonomous, or semi-autonomous, driving mode, and methods associated with monitoring and adjusting the steering column assembly 20. The operating conditions described herein for the steering wheel are standard driving mode, autonomous driving mode, and a transition mode therebetween.

In the standard driving mode, the steering column assembly 20 is extended to a location that disposes the steering wheel in a position that is comfortably reached by a driver in a manner that allows the driver to fully handle and control the steering wheel. The transition mode is defined by movement of the steering column assembly 20 during transitioning of the assembly between the standard and autonomous driving modes. An electric actuator mechanism 48 at least partially retracts the steering column assembly 20 into the instrument cluster of the vehicle during the transition mode. When the driver wants to transition back to the standard driving mode, the ADAS is deactivated and the electric actuator mechanism 48 extends the steering column assembly 20 to an extended position that allows the driver to easily handle the steering wheel. However, the embodiments described herein allow manual adjustment under certain circumstances, as described herein.

Extension and retraction of the steering column assembly 20 refers to translation of a retractable portion 28 of the steering column assembly 20. The retractable portion 28 includes one or more components that are translatable. For example, in addition to the aforementioned steering wheel and the steering shaft 26, a moveable portion, which may also be referred to as an upper jacket 28 in some embodiments, is translatable relative to a stationary portion 24, which may be referred to as a lower jacket in some embodiments. Also shown is a mounting bracket 25 that couples the steering column assembly 20 to the vehicle.

The electric actuator mechanism 48 is operatively coupled to the moveable portion 28 and the stationary portion 24 of the steering column assembly 20. A translating assembly facilitates automated telescoping (i.e., translating) and rak-

ing (i.e., tilting) of the steering column assembly. Several embodiments of translating assemblies are contemplated.

FIGS. 2 and 3 illustrate an embodiment of features of a translating assembly that facilitate adjustment of the steering column assembly 20. Multiple embodiments of a clutch device and nut are described in detail in U.S. patent application Ser. No. 15/628,836, which is incorporated by reference herein in its entirety. FIGS. 2 and 3 illustrate an example of such features, but it is to be appreciated that the embodiments described herein are applicable to any powered steering column that allows manual adjustment thereof in some conditions, with such conditions defined herein.

FIGS. 2 and 3 illustrate a screw or threaded rod 44, a shuttle assembly 46, and a drive means 48 (e.g., electric motor, see FIG. 1). The shuttle assembly 46 may include a shuttle 47 and a clutch device 58 that may be directly supported by and engaged to the shuttle 47, or a casing 56 of the shuttle 47.

The shuttle 47 of the shuttle assembly 46 may be mounted between the screw 44 and an E/A strap 29. More specifically, the shuttle assembly 46 is threadably mounted to the screw 44 for axial translation along the screw, and may be rigidly fixed to the E/A strap 29. In operation and when the electric motor 48 is rotating the screw 44, the shuttle assembly 46 axially translates along the rotating screw 44. During this axial translation, the rearward shaft portion 32 of the steering shaft 26 and the upper jacket 28 is carried by, and with, the shuttle assembly 46.

The shuttle assembly 46 may further include a nut or fixture 50, at least one bearing 52, at least one resilient member 54 (e.g., a coiled spring or a disc spring), and the casing 56. The screw 44 may be mounted for rotation to the lower jacket 24 and about a centerline 59, may not be mounted for axial translation along the lower jacket 24, and is rotatably driven by the electric motor 48 that may be rigidly mounted to the fixed lower jacket 24. The centerline 59 may be spaced from, and substantially parallel to, the axis 42.

The clutch device 58 may be mounted to the casing 56 and facilitates rotational decoupling of the nut 50 from the casing 56 (and/or shuttle 47). The clutch device 58 may include an electric servo 60 and a bolt 62. The servo 60 may be mounted to an exterior of the casing 56 and functions to move the bolt 62 into and out of at least one recess 64 defined by an external and circumferentially continuous surface of the nut 50. In one example, the recesses 64 may be axially extending grooves. The clutch device 58, including the electric servo 60 and the bolt 62 may be collectively referred to herein as a “latch” or “latch assembly.”

In the present example, the casing 56 may be an integral part of the shuttle assembly 46 (i.e., one-piece), and thus axially translates with the shuttle assembly 46. The nut 50, the bearings 52, and the spring 54 may be mounted to the screw 44 inside the casing 56. The nut 50 is threaded to the screw 44 such that rotation of the screw 44 about centerline 59 causes the casing 56 and shuttle assembly 46 to axially translate along the screw 44. A first bearing 52 may be axially located between a first spring 54 and a forward end (i.e. annular face) of the nut 50. A second bearing 52 may be axially located between a second spring 54 and a rearward end of the nut 50.

In operation and when the steering column assembly 20 is in the powered state and the clutch device 58 is engaged, the forward and rearward bearings 52 minimize any friction produced between the springs 54 and the respective ends of the nut. The axial forces produced by the torque placed upon the screw 44 by the electric motor 48 when in the powered

state are not sufficient to overcome the compressive force of the springs 54 (i.e., the springs do not compress axially).

When the steering column assembly 20 is in the decoupled state (i.e., not powered by the electric motor 48, the clutch device 58 is not engaged (i.e., the servo 60 is de-energized). A manual axial force produced by the driver to axially extend and or retract the steering column assembly 20 may cause the nut 50 to free-wheel (i.e., back spin) upon the, now stationary, screw 44 enabling the shuttle assembly 46 to axially translate.

Referring now to FIG. 4, three discrete zones—or regions—associated with positioning of the steering column assembly 20 are illustrated. The embodiments described herein provide a system and method that automatically latches and unlatches the clutch device 58 in a power column during an ADAS event. As will be appreciated from the disclosure, this eliminates the need for the driver to wait until the column unstows from the stow position and it will provide the capability to restrict driver intervention during a stow operation.

A first region may be referred to as an unstowed region and is generally referenced with numeral 100. The first region 100 defines boundaries of the telescope and rake positions where the driver may have full control of adjustability of the steering column assembly 20. In other words, the driver has full control of telescope and/or rake adjustment when the steering column assembly 20 is in the first region 100. Reference to the steering column assembly 20 being within the first region 100 refers to a specified portion or location of the steering column assembly 20 being within the first region 100. For example, the most rearward portion of the overall assembly, such as the steering input device (e.g., steering wheel) may be the reference point of the overall assembly that defines when the steering column assembly 20 is considered to be in the first region 100. However, alternative reference points of the steering column assembly 20 may be employed in some embodiments.

A second region may be referred to as a transitional region and is generally referenced with numeral 110. The second region 110 defines boundaries of the telescope and rake positions where the driver cannot manually move the steering column assembly 20 towards the instrument cluster (i.e., forward in vehicle). In other words, the driver has partial control of telescope and/or rake adjustment when the steering column assembly 20 is in the second region 110, since s/he may only adjust the steering column assembly 20 rearwardly away from the instrument cluster. Reference to the steering column assembly 20 being within the second region 110 refers to a specified portion or location of the steering column assembly 20 being within the second region 110. For example, the most rearward portion of the overall assembly, such as the steering input device (e.g., steering wheel) may be the reference point of the overall assembly that defines when the steering column assembly 20 is considered to be in the second region 110. However, as with the first region description, alternative reference points of the steering column assembly 20 may be employed in some embodiments.

A third region may be referred to as a stowed region and is generally referenced with numeral 120. The third region 120 defines boundaries of the telescope and rake positions where the driver cannot manually move the steering column assembly 20 in any direction. In other words, the driver has no control of telescope and/or rake adjustment when the steering column assembly 20 is in the third region 120. Reference to the steering column assembly 20 being within the third region 120 refers to a specified portion or location

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of the steering column assembly **20** being within the third region **120**. For example, the most rearward portion of the overall assembly, such as the steering input device (e.g., steering wheel) may be the reference point of the overall assembly that defines when the steering column assembly **20** is considered to be in the third region **120**. However, as with the first and second region descriptions, alternative reference points of the steering column assembly **20** may be employed in some embodiments.

As shown in FIG. **4**, each region **100**, **110**, **120** defines a tapering of the rake position boundary of the steering column assembly **20**. The rake position boundary is referenced with numeral **130**. Positioning and travel along the telescope path during stowing or unstowing of the steering column assembly **20**, driver restriction can be applied for safe operation and transition. The above-described restrictions, system response and/or region boundaries are configurable based on the particular application of use, thereby providing design flexibility.

The latch (FIG. **3**), i.e., clutch device **58**, is provided to control when manual extension of the steering column assembly is permitted. In particular, the nut **50** is latched in the first and second regions **100**, **110** (i.e., unstowed or transition region) so the steering column assembly can move automatically. However, if the steering column assembly is in the third region **120** (i.e., stowed), the nut **50** is unlatched to provide the driver with the option to manually pull the steering column assembly away from the stowed position for manual driving.

Referring to FIG. **5**, illustrated is a sequence of operating conditions of the steering column assembly **20**, showing a method of automatically latching and unlatching the steering column assembly **20**.

The telescope and tilt position of the steering column assembly **20** is detected at block **200**. Such detection may be made at least in part with one or more sensors or a similar detection component. The detection determines which region **100**, **110**, **120** the portion of interest of the steering column assembly (e.g., retractable portion **28**) is in at block **201**. If within the third region **120** (i.e., stowed region), the capability to manually adjust the steering column assembly in any direction is not available. Disabling of a switch or the like is shown with block **202** to illustrate the adjustment restriction. The system determines if an automated unstowing (i.e., extending) event is occurring at block **204**. If the steering column assembly **20** is not undergoing an unstowing event, the system determines if the clutch device **58** and nut **50** are unlatched at block **206**. An unlatched condition allows the driver to quickly and easily manually extend the steering column assembly to an unstowed position. If an unlatched condition is not present, unlatching occurs at block **208**.

Referring back to block **204**, if it is determined that the steering column assembly **20** is undergoing an unstowing event, the system determines if the clutch device **58** and nut **50** are latched at block **210**. If unlatched, the system commands latching to facilitate the automated unstowing action at block **211**. If latched, the automated unstowing action is performed.

Referring back to block **202**, if the steering column assembly is determined to be in the first or second region **100**, **110** (i.e., unstowed), the system determines if the clutch device **58** and nut **50** are latched at block **212**. If so, the latched state is maintained. If not, latching is commanded at block **214**.

Although the system and method described above include three discrete regions that the steering column assembly **20**

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is moveable within, it is to be understood that more or fewer regions may be included in some embodiments. For example, only two regions may be provided, with one region allowing full or partial manual adjustment capability for a driver, while the other region may allow no or partial manual adjustment capability. Similarly, more zones may be provided, each with different manual adjustment capability restrictions.

The embodiments described herein monitor the position of at least a portion of the steering column assembly **20**. The above-described latching and unlatching commands are performed by a latch motor and any suitable controllers and/or processing devices. To verify that the latch and unlatch commands occur, one or more of the following conditions may be utilized. For example, the system and method may determine if the current exceeds a current threshold, if a battery voltage based timer has expired, or if a Hall effect sensor indicates a latch or unlatch event.

While the invention has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Additionally, while various embodiments of the invention have been described, it is to be understood that aspects of the invention may include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description.

Having thus described the invention, it is claimed:

**1.** A retractable steering column assembly comprising: a retractable portion;

an electric actuator mechanism for translating and/or tilting the retractable portion; and

a latch moveable between a latched condition and an unlatched condition, the unlatched condition allowing manual adjustment of the retractable portion, the latched condition preventing manual adjustment of the retractable portion, wherein the electric actuator mechanism translates and/or tilts the retractable portion throughout a plurality of regions, the latch in the latched condition in at least one of the plurality of regions and in the unlatched condition in at least one of the plurality of regions, wherein the plurality of regions comprises a first region and a second region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, positioning of the retractable portion in the first region requiring the latch to be in the latched condition, positioning of the retractable portion in the second region requiring the latch to be in the unlatched condition.

**2.** The retractable steering column assembly of claim **1**, wherein the retractable portion is an upper jacket of the steering column assembly.

**3.** A retractable steering column assembly comprising: a retractable portion;

an electric actuator mechanism for translating and/or tilting the retractable portion; and

a latch moveable between a latched condition and an unlatched condition, the unlatched condition allowing manual adjustment of the retractable portion, the latched condition preventing manual adjustment of the retractable portion, wherein the electric actuator mechanism translates and/or tilts the retractable portion throughout a plurality of regions, the latch in the

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latched condition in at least one of the plurality of regions and in the unlatched condition in at least one of the plurality of regions, wherein the plurality of regions comprises a first region, a second region and a third region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, the second region located further from an instrument cluster than the distance between the third region and the instrument cluster, positioning of the retractable portion in the first region or the second region requiring the latch to be in the latched condition, positioning of the retractable portion in the third region requiring the latch to be in the unlatched condition.

4. The retractable steering column assembly of claim 3, wherein the steering column assembly is in an autonomous steering mode when the retractable portion is in the third region.

5. A method of controlling adjustment of a steering column assembly comprising:

detecting a position of the steering column assembly;  
determining which one of a plurality of regions the position of the steering column assembly is within;  
unlatching a latch selectively engageable with the steering column assembly to allow manual adjustment of the steering column assembly if the steering column assembly is within at least one of the plurality of regions; and

latching the latch to prevent manual adjustment of the steering column assembly if the retractable portion is within at least one of the plurality of regions, wherein detecting the position comprises detecting a position of a portion of a retractable portion of the steering column assembly, wherein the plurality of regions comprises a first region, a second region, and a third region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, the second region located further from an instrument cluster than the distance between the third region and the instrument cluster, detecting whether the latch is in the latched condition while the retractable portion is in the first region and the second region.

6. The method of claim 5, further comprising moving the latch to the latched condition while the retractable portion is in the first region and the second region if the latched condition is not detected.

7. A method of controlling adjustment of a steering column assembly comprising:

detecting a position of the steering column assembly;  
determining which one of a plurality of regions the telescope position of the steering column assembly is within;

unlatching a latch selectively engageable with the steering column assembly to allow manual adjustment of the steering column assembly if the steering column assembly is within at least one of the plurality of regions; and

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latching the latch to prevent manual adjustment of the steering column assembly if the retractable portion is within at least one of the plurality of regions, wherein detecting the position comprises detecting a position of a portion of a retractable portion of the steering column assembly, wherein the plurality of regions comprises a first region, a second region, and a third region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, the second region located further from an instrument cluster than the distance between the third region and the instrument cluster, wherein positioning of the retractable portion in the first region or the second region requires the latch to be in the latched condition, positioning of the retractable portion in the third region requires the latch to be in the unlatched condition.

8. A method of controlling adjustment of a steering column assembly comprising:

detecting a position of the steering column assembly;  
determining which one of a plurality of regions the telescope position of the steering column assembly is within;

unlatching a latch selectively engageable with the steering column assembly to allow manual adjustment of the steering column assembly if the steering column assembly is within at least one of the plurality of regions;

latching the latch to prevent manual adjustment of the steering column assembly if the retractable portion is within at least one of the plurality of regions, wherein detecting the position comprises detecting a position of a portion of a retractable portion of the steering column assembly, wherein the plurality of regions comprises a first region, a second region, and a third region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, the second region located further from an instrument cluster than the distance between the third region and the instrument cluster; and

determining whether the retractable portion is being automatically extended while the retractable portion is in the third region.

9. The method of claim 8, further comprising detecting whether the latch is in the latched condition while the retractable portion is being automatically extended.

10. The method of claim 9, further comprising moving the latch to the latched condition if the latched condition is not detected.

11. The method of claim 8, further comprising detecting whether the latch is in the unlatched condition while the retractable portion is not being automatically extended.

12. The method of claim 11, further comprising moving the latch to the unlatched condition if the unlatched condition is not detected.

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